Geometric Misfitting in Structures – Interval-Based Approach

M.V. Rama Rao[1)], **R. L. Muhanna**[2)], **and R. L. Mullen**[3)]

[1)] Vasavi College of Engineering, Hyderabad - 500 031 INDIA
dr.mvrr@gmail.com

[2)] School of Civil & Env. Eng., Georgia Institute of Technology, Atlanta, GA 30332,
rafi.muhanna@ gatech.edu

[3)] School of Civil and Env. Eng., University of South Carolina, Columbia, SC, 29208,
rlm@cec.sc.edu

Keywords: *Interval; Interval Finite Elements; Uncertainty; Misfitting; Geometry.*

Abstract

Engineering systems are usually designed with a pre-described geometry in order to meet the intended function for which they are designed. However, due to fabrication errors and/or thermal changes, the dimensions of system components will deviate from their nominal values creating a missfitting problem during the manufacturing/construction process. In engineering practice, such a fabrication deviation is defined in a form of maximum allowable tolerance for individual components or for the completed system after the assemblage. Usually, the design and manufacturing processes of mechanical components require a complete definition of geometry of these components, however the definition of the geometries of the components are only considered complete if tolerances are included in the design. (Henzold, G., 1995).

Tolerances, usually, are defined as absolute deviation from the nominal values. Thus, including the tolerance, in the analysis and design, as a possible value within a given interval that possesses known bounds might be a realistic or natural way of representing such type of uncertainty.

The present work eliminates the element force overestimation resulting in our previous formulation (Muhanna, et al, 2006). Here the used Element-By Element technique is resulting in exact nodal displacements and element forces. Dependency has been eliminated using the M matrix approach (Mullen, et al, 1999) and forces are obtained as a part of the system solution. Examples are presented.

References

Henzold, Georg, Handbook of Geometrical Tolerancing, Design, Munufacturing and Inspection. John Wiley & Sons Ltd., England, 1995.

Rafi L. Muhanna, Ayše Erdolen and Robert Mullen, "Geometric Uncertainty in Truss Systems: An Interval Approach", *Proceedings of the NSF Workshop on Reliable Engineering Computing*, Georgia Tech, Savannah, GA, February 22-24, 2006.

Mullen, R. L., and Muhanna, R. L. Bounds of structural response for all possible loadings, *J. Struct. Engrg.*, ASCE, 125(1), 98–106, 1999.